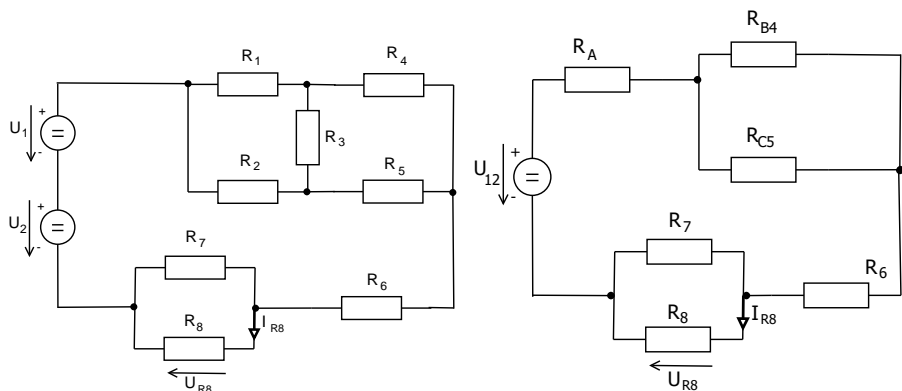


**Semestrálny projekt
IEL 2016**

**Anton Firc
(xfirca00)**

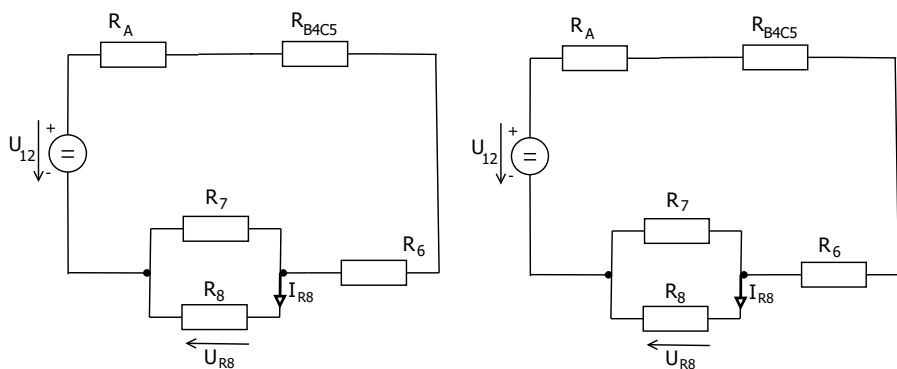
Príklad 1



$$R_A = \frac{R_1 * R_2}{R_1 + R_2 + R_3}$$

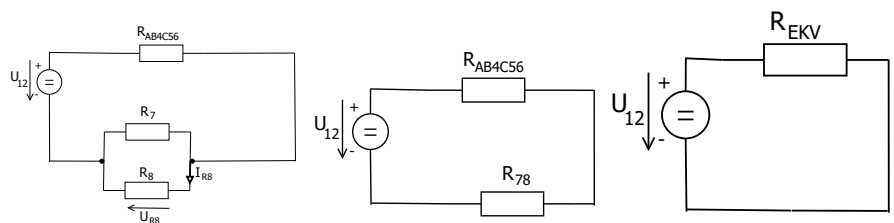
$$R_B = \frac{R_1 * R_3}{R_1 + R_2 + R_3}$$

$$R_C = \frac{R_2 * R_3}{R_1 + R_2 + R_3}$$



$$R_{B4} = R_B + R_4 \quad R_{C5} = R_C + R_5$$

$$R_{B4C5} = \frac{R_{B4} * R_{C5}}{R_{B4} + R_{C5}}$$



$$R_{AB4C56} = R_A + R_{B4C5} + R_6$$

$$R_{78} = \frac{R_7 * R_8}{R_7 + R_8}$$

$$R_{Ekv} = R_{AB4C56} + R_{78}$$

Dosadíme hodnoty podľa zadania :

$$\begin{aligned} R_{Ekv} &= R_{AB4C56} + R_{78} = R_A + R_{B4C5} + R_6 + 142.2414 = \\ &= 163.4615 + 142.2414 + 800 + R_{B4C5} = 1105.7029 + \frac{(R_B + R_4) * (R_C + R_5)}{(R_B + R_4) + (R_C + R_5)} = \\ &= 1105.7029 + 225.9265 = 1331.6294 \Omega \end{aligned}$$

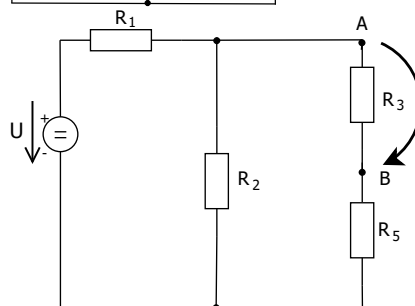
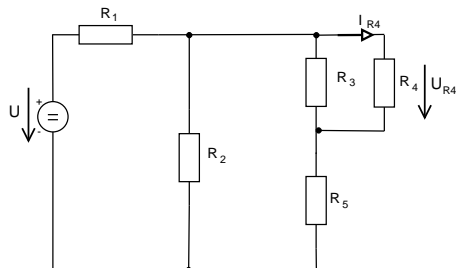
$$I = \frac{U}{R_{Ekv}} = \frac{190}{1331.6294} = 0.1427 A$$

$$U_{R_{78}} = R_{78} * I = 142.2414 * 0.1427 = 20.2956 V$$

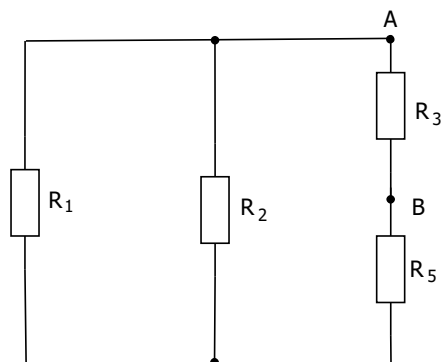
$$U_{R_8} = U_{R_{78}} = 20.2956 V$$

$$I_{R_8} = \frac{U_{R_8}}{R_8} = \frac{20.2956}{250} = 0.0812 A = 81.2 mA$$

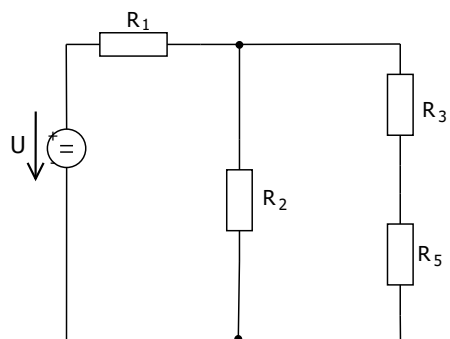
Príklad 2



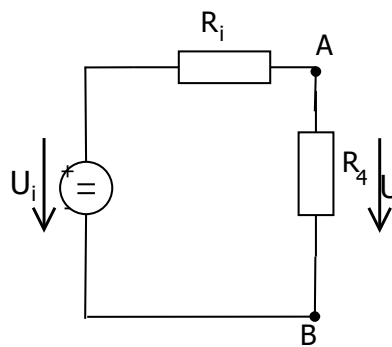
$$\begin{aligned}
 U_{R_{35}} &= (U - U_{R_1}) = \\
 &= 220 - (360 * 0.342) = 96.88V \\
 I_{R_{35}} &= \frac{U_{R_{35}}}{R_3 + R_5} = 0.1746A \\
 U_{R_3} &= R_3 * I_{R_{35}} = 35.793V \\
 U_i &= U_{R_3} = 35.793V
 \end{aligned}$$



$$\begin{aligned}
 R_{AB} &= \frac{R_3 * R_{125}}{R_3 + R_{125}} = \frac{205 * (350 + R_{12})}{555 + R_{12}} = \\
 &= \frac{205 * (572.1277)}{777.1277} = 150.9226\Omega \\
 R_i &= R_{AB} = 150.9226\Omega
 \end{aligned}$$

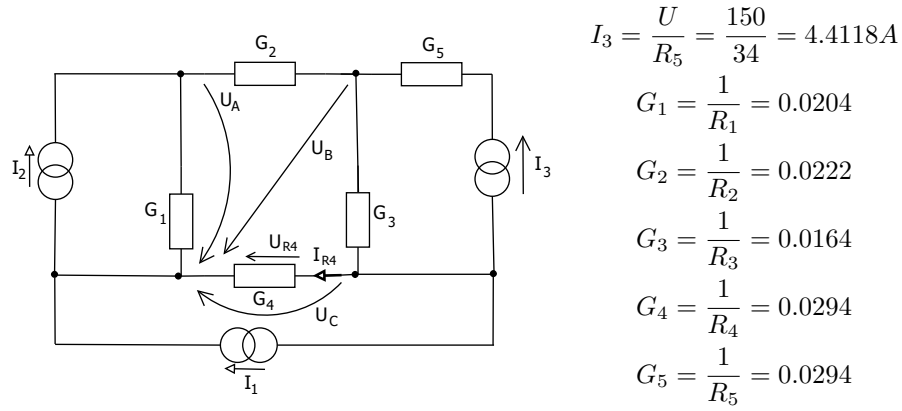
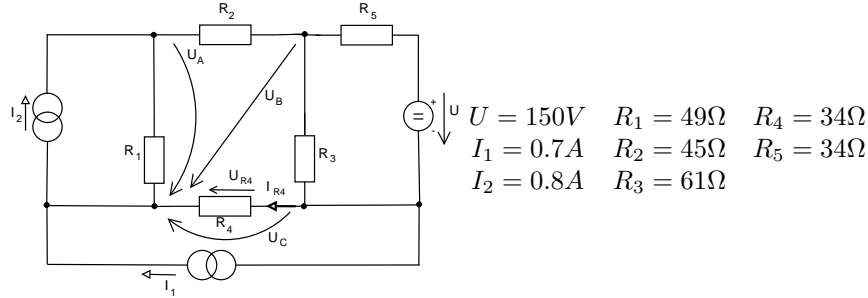


$$\begin{aligned}
 I_x &= \frac{U}{R_{1235}} R_{1235} = R_1 + R_{235} = \\
 &= 360 + \frac{R_2 * (R_3 + R_5)}{R_2 + R_3 + R_5} = \\
 &= 360 + \frac{580 * 555}{580 + 555} = 643.61\Omega \\
 I_x &= \frac{220}{643.61} = 0.342A
 \end{aligned}$$



$$\begin{aligned}
 I &= \frac{U_i}{R_i + R_4} = \frac{35.793}{150.9226 + 560} = 0.0503A \\
 U_{R_4} &= R_4 * I = 560 * 0.0503 = 28.1945V \\
 I_{R_4} &= I = 0.05A = 50.03mA
 \end{aligned}$$

Príklad 3



$$\begin{aligned}
 U_a(G_1 + G_2) - U_b(G_2) &= 0.8 \\
 -U_a(G_2) + U + b(G_2 + G_3 + G_5) - U_c(G_3 + G_5) &= 0.7 \\
 -U_b(G_3 + G_5) + U_c(G_3 + G_4 + G_5) &= 5.1118
 \end{aligned}$$

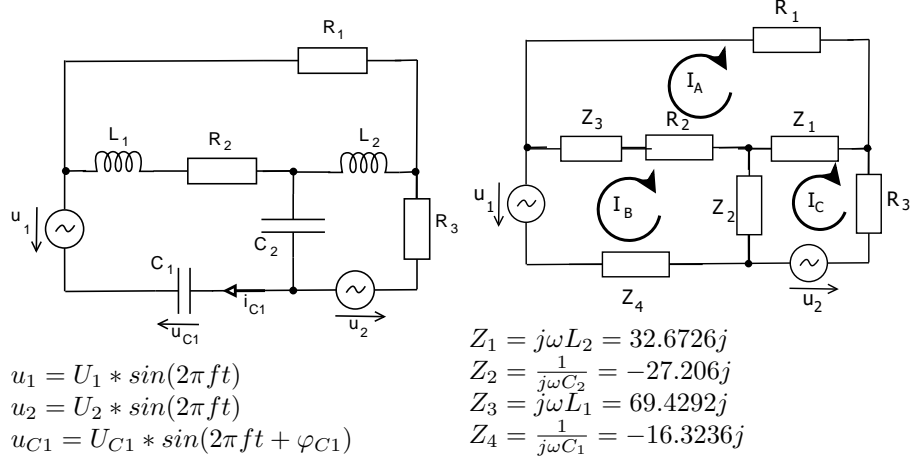
$$\begin{pmatrix} 0.0426 & -0.0222 & 0 \\ -0.0222 & 0.068 & -0.0458 \\ 0 & -0.0458 & 0.0752 \end{pmatrix} * \begin{pmatrix} U_a \\ U_b \\ U_c \end{pmatrix} = \begin{pmatrix} 0.8 \\ 0.7 \\ 5.1118 \end{pmatrix}$$

$$\begin{aligned}
 D_s &= (0.0426 * 0.068 * 0.0752) - (-0.0458 * (-0.0458) * 0.0426) - \\
 &\quad - (0.07528 * (-0.0222) * (-0.0222)) = 0.00009141 \\
 D_c &= (0.0426 * 0.068 * 5) + (0.8 * (-0.0222) * (-0.0458)) - \\
 &\quad - (-0.0458 * 0.7 * 0.0426) - (5.1118 * (-0.0222) * (-0.0222)) = -0.0028538
 \end{aligned}$$

$$U_{R_4} = U_c = \frac{D_3}{D_s} = -31.2198V$$

$$I_{R_4} = \frac{U_{R_4}}{R_4} = -0.9182A$$

Príklad 4



$$\omega = 2\pi f = 2\pi 65 = 408.407 \text{ rad} * s^{-1}$$

$I_A :$

$$U_{R_1} + U_{Z_1} + U_{R_2} + U_{Z_3} = 0$$

$$I_A R_1 + (I_A - I_C) Z_1 + (I_A - I_B) R_2 + (I_A - I_B) Z_3 = 0$$

$$I_A (R_1 + Z_1 + R_2 + Z_3) + I_B (-R_2 - Z_3) + I_C (-Z_1) = 0$$

$$I_A (22 + 102.1018j) + I_B (-10 - 69.4292j) + I_C (-32.6726) = 0$$

$I_B :$

$$U_{Z_4} - U_1 + U_{Z_3} + U_{R_2} + U_{Z_2} = 0$$

$$I_B Z_4 - U_1 + (I_B - I_A) Z_3 + (I_B - I_A) R_2 + (I_B - I_C) Z_2 = 0$$

$$I_A (-Z_3 - R_2) + I_B (Z_4 + Z_3 + R_2 + Z_2) + I_C (-Z_2) = 20$$

$$I_A (-69.4292j - 10) + I_B (25.8996j + 10) + I_C (27.206j) = 20$$

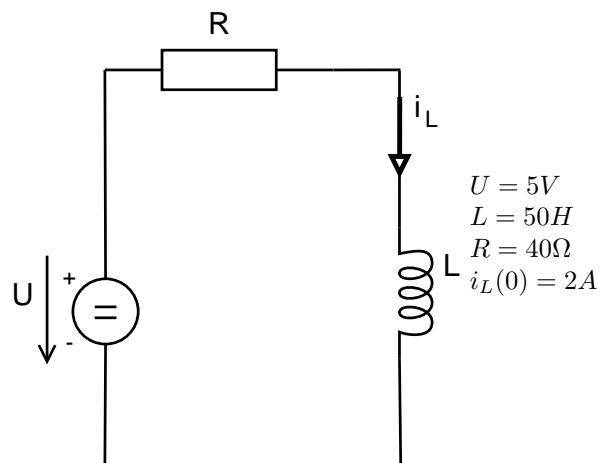
$$\begin{aligned}
I_C : \\
U_{R_3} - U_2 + U_{Z_2} + U_{Z_1} &= 0 \\
I_C R_3 - U_2 + (I_C - I_B)Z_2 + (I_C - I_A)Z_1 &= 0 \\
I_A(-Z_1) + I_B(-Z_2) + I_C(R_3 + Z_2 - Z_1) &= 35 \\
I_A(-32.6726j) + I_B(27.206j) + I_C(15 - 5.4666j) &= 35
\end{aligned}$$

$$\begin{pmatrix} 22 + 102.1018j & -10 - 69.4292j & -32.6726j \\ -10 - 69.4292j & 10 + 25.8996j & 27.206j \\ -32.6726j & 27.206j & 15 - 5.4666j \end{pmatrix} * \begin{pmatrix} I_A \\ I_B \\ I_C \end{pmatrix} = \begin{pmatrix} 0 \\ 20 \\ 35 \end{pmatrix}$$

$$\begin{aligned}
I_A &= 1.0043j + 0.7827A \\
I_B &= 0.877j + 0.6901A \\
I_C &= 0.9587j + 1.3872A
\end{aligned}$$

$$\begin{aligned}
u_{C_1} &= I_B * Z_4 = (0.877j + 0.6901) * -16.3236j = 14.3158 - 11.2649jV \\
|U_{C_1}| &= \sqrt{Re^2 + Im^2} = \sqrt{(14.3158)^2 + (-11.2649j)^2} = 18.2165V \\
\varphi &= \arctan \frac{Im}{Re} = \arctan -0.7869 = -0.6415rad \\
UC_1 &= \frac{|U_{C_1}|}{\sin(\omega t + \varphi)} = \frac{18.2165}{\sin \frac{\omega \pi}{2\omega} + \varphi} = \frac{18.2165}{\sin(\frac{\pi}{2} - 0.6415)} = 22.7365V
\end{aligned}$$

Príklad 5



$$i_L = i_R = i \Rightarrow u_L = U - R * i$$

$$i'_L = \frac{1}{L} * u_L \Rightarrow i'_L = \frac{1}{L} * (U - R * i)$$

Riešenie v tvare : $i_L = c(t) * e^{\lambda t}$

$$i'_L = \frac{1}{50}(5 - 40i)$$

$$i'_L = \frac{5}{50} - \frac{40i}{50}$$

$$50i'_L = 5 - 40i$$

$$50i'_L + 40i_L = 5$$

$$10i'_L + 8i_L = 1$$

$$10\lambda + 8 = 0 \Rightarrow \lambda = -0.8$$

$$10(c'(t) * e^{-0.8t} - 0.8c(t) * e^{-0.8t}) + 8(c(t) * e^{-0.8t}) = 1$$

$$10(c'(t) * e^{-0.8t}) - 8(c(t) * e^{-0.8t}) + 8(c(t) * e^{-0.8t}) = 1$$

$$10(c'(t) * e^{-0.8t}) = 1$$

$$c'(t) * e^{-0.8t} = 0.1$$

$$c'(t) = \frac{0.1}{e^{-0.8t}}$$

$$\int c'(t) * dt = \int \frac{0.1}{e^{-0.8t}} * dt$$

$$c(t) + K_1 = 0.125e^{0.8t} + K_2$$

$$c(t) = 0.125e^{0.8t} + K$$

$$i_L = (0.125e^{0.8t} + K) * e^{-0.8t}$$

$$*i_L(0) = 2A*$$

$$2 = 0.125 + K$$

$$K = 1.875$$

$$\text{Výsledný prúd } i_L = 0.125 + 1.875e^{-0.8t}$$

Kontrola výsledku :

$$10(-1.5e^{-0.8t} + 8(0.125 + 1.875e^{-0.8t})) = 1$$

$$-15e^{-0.8t} + 1 + 15e^{-0.8t} = 1$$

$$1 = 1$$

Tabuľka 1: Výsledky

Príklad	Varianta	Výsledok
1.	F	$U_{R_8} = 20.2956V I_{R_8} = 81.2mA$
2.	H	$U_{R_4} = 28.1945V I_{R_4} = 50.03mA$
3.	B	$U_{R_4} = -31.2198V I_{R_4} = -0.9182A$
4.	F	$U_{C_1} = 22.7365V \varphi_{C_1} = -0.6415rad$
5.	H	$i_L = 0.125 + 1.875e^{-0.8t}$